Studies on the Freshwater Oligochaeta of South India

I. Aeolosomatidae and Naididae

PART 5

BY

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(*With eight text-figures*)

[*Continued from Vol.* **59** (3) : 921]

c. Subfamily STEPHENSONIANINAE nov.

Type genus : *Stephensoniana* Černosvitov

Prostomium simple. No eyes. Dorsal setae begin in II, consist of hairs and needles. Ventral setae of 2 types. Pharynx with dorsal diverticulum. Coelomocytes absent. Nephridia present. Testes and spermathecae in IV ; ovaries and atria in V. Four segments formed anteriorly by budding.

9. Genus **Stephensoniana** Černosvitov, 1938

Generic characters : Prostomium triangular. Dorsal bundles from II with hairs and simple-pointed anodulate needles. Ventral setae of II-V distinct from the rest. Stomach absent. Septa present, no septal glands. Dorsal vessel lateral mostly, mid-dorsal anteriorly. Budding zone single.

28. **Stephensoniana trivandrana** (Aiyer, 1926)

Fig. 28 A-D

Stephensoniana trivandrana (Aiyer). Sperber, 1948, pp. 208-209, fig. 28c.

Material examined : Several worms collected from the Bugga stream, Cuddapah, in May and December 1955 ; from the Brucepettah tank, Bellary, in April 1954.

Worms small, filiform, reddish brown, tapering abruptly from VI anteriorly, gradually from middle to posterior end. Prostomium bluntly

triangular. Eyes absent. Anterior $\frac{1}{2}$-$\frac{2}{3}$ covered by mucus sheath to which fine sand particles and clay adhere around annuli and give papillated appearance ; posterior $\frac{1}{2}$-$\frac{1}{3}$ delicate without sheath, probably for respiration.

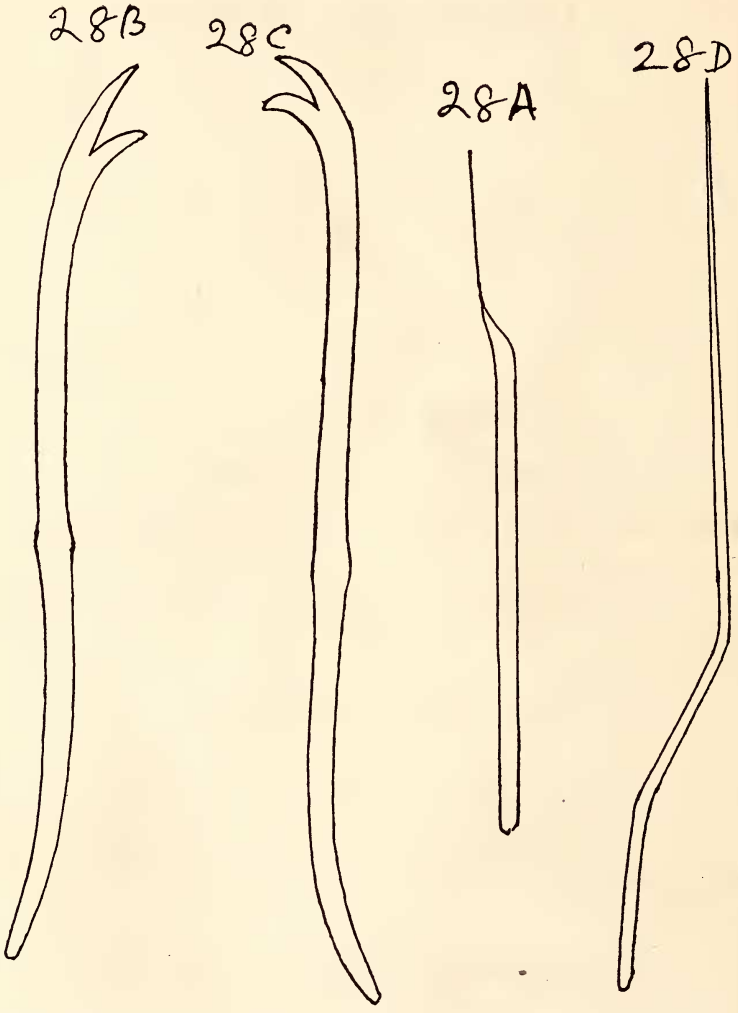

Fig. 28. *Stephensoniana trivandrana* (Aiyer): A. Needle seta × 1450 ; B. Ventral seta of II × 1450 ; C. Ventral seta of V × 1450 ; D. Hair seta × 1000.

Dorsal setae start in II, 3-5 hairs and 3-5 needles in couples of 1 hair and 1 needle per bundle. Hair (Fig. 28 D) clearly bayonet-shaped, 115-175 μ long. Needle (Fig. 28 A) simple, straight, suddenly tapering and slightly curved near the tip, without nodulus, 42-52·5 μ long. Ventral setae (Fig. 28 B, C) 4 per bundle anteriorly, decreasing to 1 posteriorly ; in II-IV straight with proximal nodulus (D : P :: 14 :12), 77-93 μ

long, less curved, distal prong thicker and longer than proximal; in rest 76-91 μ long with distal nodulus (D : P :: 16 : 10), distal prong twice as long and as thick as proximal and prongs end in sharp points.

Pharynx in II-III, wide with dorsal diverticulum protrusible through mouth for feeding. Oesophagus in IV-V, thin and sinuous. Stomach absent. Intestine starts in VI and wide all through. Chloragogues cover the gut from VI, and brown. Intestinal antiperistalsis and ascending ciliary vibration occur. Septa well developed; no septal glands. Coelomocytes absent. Intestinal wall posteriorly has orange-red pigment.

Blood orange-red. Dorsal vessel ventrally attached to gut on the left from hind end to V, where it takes a spiral course and runs mid-dorsally in anterior segments. Contractile vascular vessels 1 pair in V, connect dorsal and ventral vessels.

First nephridium in VI with its pre-septal funnel in V; post-septal has a fusiform ampulla and a long coiled duct ending in nephridiopore ventrally.

One budding zone developed at a time; some hind segments for anterior zooid are budded off earlier than prostomium and four anterior segments of posterior zooid, before fission.

Sexual worms not encountered.

1 (p.) = 2 mm.; d (p.) = 0.2 mm.; s = 32 + undifferentiated zone; n = 12-14.

Lengths of longest setae in μ and position of nodulus in ratio D : P : :

	II	III	IV	V
Hair	126	157	175	175
Needle	42	52.5	52.5	52.5
V. seta	92.7	91	77	91
	14:12.5	14:12	12:10	16:10

Distribution in Indian sub-continent : Trivandrum in Travancore (S. India). Now recorded from Cuddapah and Bellary (S. India).

Remarks : The worms move very slowly on muddy substratum and wriggle briskly in water. When disturbed or taken into pipette they coil into flat and close spirals like *Aulophorus michaelseni* and *Pristina synclites*. Stomach absent. Gut abruptly widens in VI and continues so throughout.

Parasites : Large number of holotrichus astomatous ciliate parasites have been found in the gut of several worms. These parasites emerge out of their bodies through the mouth when slight pressure is exerted on them with cover glass on slides.

Habits : Swim by brisk wriggling movement.

Subfamily PRISTININAE Lastočkin, 1924

10. Genus **Pristina** Ehrenberg, 1828

Generic characters : No eyes. Prostomium with or without proboscis. Dorsal setae from II or III or IV, hairs and needles ; ventral setae all of one type. Pharyngeal glands present ; stomach fusiform or pear-shaped, usually with intracellular canals. Intestinal anti-peristalsis and ascending ciliary vibration occur. Septa well developed; septal glands present. Coelomocytes present. Dorsal vessel median (lateral in *P. synclites*). Nephridia start in IX, with pre-septal and post-septal in two successive segments. Budding zones 1-3, produce prostomium and seven anterior segments to the posterior zooid and some hind segments to the anterior zooid before fission.

KEY TO ALL THE KNOWN AND VALID SPECIES AND SUBSPECIES OF *PRISTINA*

A-1 Needles simple-pointed
- B-1 Prostomium with proboscis ; needles fine, straight
  - C-1 Dorsal setae beginning in II
    - D-1 Hairs of III specially elongated
      - E-1 Distal tooth of ventral setae of II and III nearly twice as long as proximal .. *longiseta longiseta*
      - E-2 Distal tooth of ventral setae of II and III thrice as long as proximal
        - F-1 Ventral setae of III fewer than in following segments ; serrations of hair close and fine .. **longiseta sinensis*
        - F-2 Ventral setae of III not fewer than in following segments; teeth of serrations of hair far apart .. **longiseta leidyi*
    - D-2 Hairs of II-VII shorter, in others specially elongated .. **biserrata*
    - D-3 Hairs not specially elongated in any segment *proboscidea*
  - C-2 Dorsal setae beginning in III or IV .. **macrochaeta*
- B-2 Prostomium without proboscis; needles bayonet-shaped .. *menoni*

A-2 Needles double-pointed
- G-1 Prostomium with proboscis
  - H-1 Hairs specially elongated in one or more segments
    - I-1 Hairs of III specially elongated .. **longiseta bidentata*
    - I-2 Hairs of IV-VI specially elongated .. **schniederi*
  - H-2 No specially elongated hair in any segment
    - J-1 Needle teeth fine
      - K-1 Giant ventral setae present
        - L-1 Giant ventral setae in IV, bifid .. *aequiseta*
        - L-2 Giant ventral setae in V, single pointed .. *evelinae*

* Species not known from the Indian sub-continent.

K-2 Giant ventral setae absent
M-1 Dorsal bundles with not more than 4 hairs and 4 needles; ventral setae of III not shortest; length of worms up to 6.5 mm. .. *foreli*
M-2 Dorsal bundles with 1 hair and 1 needle; ventral setae of III shortest; length of worms up to 2 mm. .. *sperberae* sp. nov.
J-2 Needle teeth long and unequal
N-1 Distal tooth of needles longer than proximal .. **plumaseta*
N-2 Distal tooth of needles shorter than proximal
O-1 Distal tooth of needle slightly shorter than proximal; hairs non-serrate .. *synclites*
O-2 Distal tooth of needle about half as long as the proximal; hairs serrate .. **americana*
J-3 Needle teeth long and equal
P-1 Needle teeth diverging; dorsal bundles with 1 hair and 1 needle; hair non-serrate; stomach in VII .. *breviseta*
P-2 Needle teeth parallel; dorsal bundles with 2-4 hairs and 1-3 needles; hairs closely serrate; stomach in VIII .. **peruviana*
G-2 Prostomium without proboscis
Q-1 Needle teeth short and about equal
R-1 Dorsal setae stout in III; hairs of III-IV specially elongated up to 1200 μ long .. **bilongata*
R-2 Dorsal setae start in II; hairs not specially elongated in any segment
S-1 Intermediate teeth 2-3 between main teeth in needles .. **sima*
S-2 No intermediate teeth between main needle teeth
T-1 Needle teeth parallel; hairs serrate **bilobata*
T-2 Needle teeth diverging with wide angle; hair non-serrate .. *minuta*
T-3 Needle teeth diverging at acute angle; hairs serrate .. **notopora*
Q-2 Needle teeth long, distal tooth shorter than proximal
U-1 Distal tooth of needles much shorter than proximal, teeth diverging; hair non-serrate; needles thicker in IV (and V) than in others **amphibiotica*
U-2 Distal tooth of needles shorter than proximal
V-1 Needle teeth parallel and long, distal slightly shorter than proximal; needles in IV longer and stouter than in others; hairs non-serrate .. **idrensis*

* Species not known from the Indian sub-continent.

V-2 Needle teeth diverging ; distal tooth about half as long as proximal
W-1 Proximal tooth of needles 5-10 μ long; hairs non-serrate ; nodulus median in anterior ventral setae and distal in others .. *jenkinae*
W-2 Proximal tooth of needles 3-5 μ long ; hairs finely serrated ; all ventral setae with slightly distal nodulus .. **rosea*

29. **Pristina minuta** (Stephenson, 1914)

Fig. 29 A-C

Naidium minutum Stephenson. Stephenson, 1915 a, p. 786.
Pristina minuta (Stephenson). Sperber, 1948, pp. 222-223.

Material examined : Several worms collected from the Bugga stream, Cuddapah, in December 1955 and January 1956.

Worms pale white, minute, slender. Prostomium bluntly triangular without proboscis. Anterior 7 segments shorter than succeeding segments in all adult worms. Anus in a notch bounded by 2 lobes on either side.

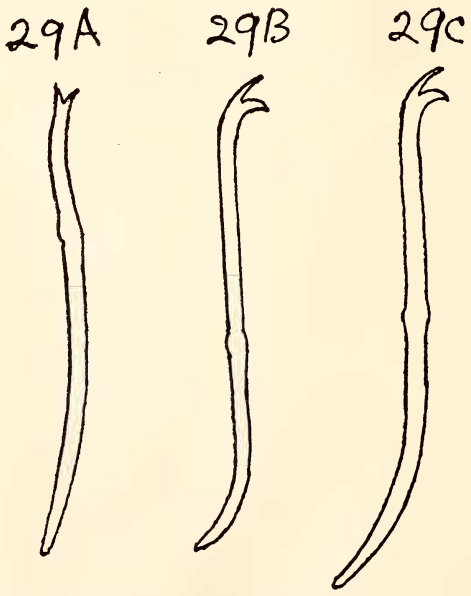

Fig. 29. *Pristina minuta* (Stephenson) : A. Needle seta × 2000 ; B. Ventral seta of II × 2000 ; C. Ventral seta of a middle segment × 2000.

*Species not known from the Indian sub-continent.

Dorsal setae start in II, each bundle with 1 hair and 1 needle. Hairs non-serrate, straight, 91-112 μ long. Needles (Fig. 29A) bifid, 24.5-35 μ long, with distal nodulus (D : P : : 3 : 7), teeth of equal length and diverging. Ventral setae (Fig. 29 B, C) 3-5 per bundle, decreasing to 2-3 posteriorly, 31.5-36.5 μ long, shortest in II gradually increasing in succeeding segments, nodulus median (D : P : : 5 : 4 or 5.5 : 5.5), prongs of equal thickness, distal longer than proximal.

Pharynx in II-IV ; oesophagus in V-VII ; stomach in VIII, abrupt and pear-shaped ; intestine thin and flexed on itself in IX and wide from X. Chloragogues begin in VIII, yellowish brown. Coelomocytes granular, morula-like, grey, largest 14 μ in diameter. Septal glands on 4/5, 5/6 and 6/7.

Blood tinged with light shade of red. Dorsal vessel contractile and mid-dorsal.

Nephridia in IX-XII or XIII, 1 per segment. Each nephridium has nephrostome-bearing pre-septal funnel in one segment and post-septal with a long coiled duct and nephridiopore in next segment.

Only one budding zone develops at a time in a worm.

Sexual worms not encountered.

l (living) = 1.5-1.85 mm. ; d (living) = 0.13 mm. ; s = 16 ; n = 12.

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

	II	III	IV	V	VI	VII	VIII	IX	X	XI
Hair	91	94	101.5	108.5	112	108.5	87.5	87.5	91	—
Needle	26.3	28	31.5	33.3	35	35	35	35	35	35
	3:4.5	3:5	3:6	3:6.5	3:7	3:7	3:7	3:7	3:7	3:7
V. seta	31.5	35	35	36.5	36.5	38.5	38.5	38.5	35	36.7
	5:4	5:5	5:5	5.5:5	5:5.5	5.5:5.5	5.5:5.5	5.5:5.5	5:5	5:5.5

Distribution in Indian sub-continent : Lahore (Pakistan). Now recorded from Cuddapah (S. India).

Habits : No swimming. Backward progression present.

Remarks : These worms have longer needle teeth than the worms of Stephenson. Length of setae, body length, and segment number of the present worms agree with those given by Stephenson (1914), and Marcus (1943).

Naidium osborni Walton (1906, Galloway 1911, Smith 1918) with l = 1.6 mm., s = 15-16, stomach in VIII, agrees very well with *Pristina minuta* (Stephenson). It, however, differs greatly from the latter in having very much longer needles and hairs (needles 50 μ as against 35 μ and hairs 140 μ as against 120 μ). If they are identical, *N. osborni* (with similar body length as *Pr. minuta*) ought to have had setae of similar length. With very much longer setae (particularly needles) for such a small specimen, as Marcus (1943) suggested, it is not identical with *Pr. minuta*, but a distinct species *Pr. osborni* (Walton).

30. **Pristina synclites** Stephenson, 1925

Fig. 30 A-D

Pristina synclites Stephenson. Sperber, 1948, p. 225.

Material examined : Several worms collected from the Bugga stream, Cuddapah, in March 1954, May 1955 ; from the Kandakam tank, Bellary, in April 1954 ; from Miller's tank and Langford Town tank, Bangalore, in May 1958.

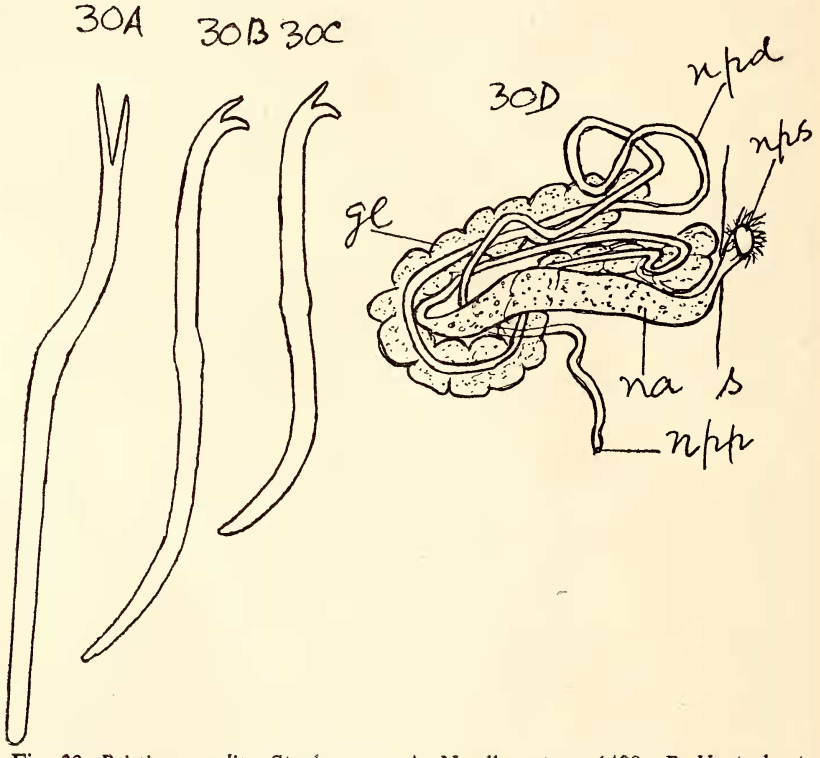

Fig. 30. *Pristina synclites* Stephenson : A. Needle seta × 1400 ; B. Ventral seta of II × 1400 ; C. Ventral seta of a posterior segment × 1000 ; D. Nephridium.
gl : gland ; *na* : nephridial ampulla ; *npd* : nephridial duct ; *npp* : nephridiopore ; *nps* : nephrostome ; *s* : septum.

Worms largest among the 7 species of *Pristina* in the locality, light red in colour. Posterior half of body is slender, highly vascularised, decreasing gradually in diameter to blunt hind end. Prostomium with a delicate proboscis, with sensory hairs, frequently breaking off partly or wholly. Proboscis shorter than the triangular prostomium.

Dorsal setae start in II, each bundle with 1-2 hairs and 1-2 needles. Hairs slightly bayonet-shaped, non-serrate 175-350 μ long, shorter than body-diameter. Needles (Fig. 30A) bifid, bayonet-shaped 70-101.5 μ long, with weak, distal nodulus (D : P : : 9 : 17), teeth faintly diverg-

ing, proximal slightly longer and thicker than distal. Ventral setae (Fig. 30 B, C) 4 per bundle, decreasing to 2 posteriorly, 63-87.5 μ long, length increasing from II-V and gradually decreasing from VI onwards. Nodulus median in II-IV and distal from V on. Prongs equally long, distal thinner than proximal.

Pharynx in II-½IV, wide. Oesophagus in ½IV-VI, thin and straight. Stomach in VII-VIII, gradual and fusiform without intracellular canals. Intestine thin and wavy in IX-XI, wide and sacculated behind, opening at hind end in a notch. Chloragogues cover from VI on, brownish and cover also dorsal vessel. Septal glands in IV-V. Coelomocytes grey, granular, spherical and largest measure 17.5μ in diameter.

Brain incised deeply in front and less deeply behind.

Blood orange-red. Dorsal vessel contractile, laterally attached to left of gut up to XII, unattached in IX-VIII, again attached in VII-VI, and mid-dorsal in anterior 5 segments. Contractile lateral vessels, 4 pairs, first 2 pairs in the middle of IV and V, other 2 pairs nearer posterior septa of VI and VII. Non-contractile loops in II-III. Dorsal vessel thicker in slender hind part of body and gives off several non-contractile vessels to body-wall, 1 pair per segment. Vascular plexus exists anteriorly.

First nephridium (Fig. 30 D) in IX with its short pre-septal funnel in VIII ; post-septal with a long cylindrical granular ampulla followed by a coiled duct, partly passing through gland tissue and opening by nephridiopore.

Single budding zone common, 2 zones rare ; buds off hind part of anterior zooid and proboscid prostomium and 7 anterior segments to posterior zooid before they separate. In fact it is only after the production of hind part to anterior zooid budding of anterior segments to posterior zooid takes place.

l (p.) =4-4.5 mm. ; d (p.) =0.35 mm. ; s = 42-63 ; n =18-23.

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

Cuddapah worm

	II	III	IV	V	VI	VII	VIII	IX	X	XI
Hair	126	182	238	241.5	245	255.5	259	259	266	227.5
Needle	52.5	61.5	75.2	80.5	80.5	80.5	80.5	80.5	80.5	77
	5:10	6:9.5	8:13.5	10:13	10:13	10:13	10:13	10:13	10:13	9:13
V. seta	63	63	77	70	73.5	73.5	73.5	73.5	73.5	73.5
	9:9	9:9	10:12	9:11	10:11	10:11	10:11	10:11	10:11	10:11

Bellary worm

	II	III	IV	V	VI	VII	VIII	IX	X	XI
Hair	175	227.5	266	350	315	371	280	201	301	301
Needle	70	73.5	89.3	94.5	91	98	101.5	87.5	87.5	87.5
	7:13	7:14	6.5:17	9:18	9:17	9:19	9:20	9:16	9:16	9:16
V. seta	63	66.5	73.5	80.5	84	77	77	73.5	71.7	73.5
	9:9	9.5:9.5	10:11	10:13	10:14	10:12	9:13	9:12	9:11.5	9:12

Distribution in Indian sub-continent: Recorded only from Mysore (S. India). Now recorded from Cuddapah, Bellary, and Bangalore (S. India).

Habits: Worms coil into flat spirals when disturbed. They live in soft mud along with *Dero dorsalis*, *Aulophorus michaelseni*, *Limnodrilus socialis*, etc. Swimming absent.

Remarks : Needles and ventral setae of these specimens are longer than in the specimens of Stephenson (1925b). As reported by Stephenson the hind half of the body has numerous vascular loops similar to those seen in the tubificids. During budding the hind segments of the anterior zooid are budded off before the anterior segments of the posterior zooid start forming.

31. **Pristina jenkinae** (Stephenson, 1931)

Fig. 31 A-B

Pristina jenkinae (Stephenson). Sperber 1948, pp. 224-225 ; 1958, p. 51, fig. 17.

Pristina rosea (Piguet). Yamaguchi, 1953, p. 286.

Material examined: One worm collected from the Kandakam tank, Bellary, in May 1954.

Worm small and pale white. Prostomium bluntly triangular without proboscis.

Dorsal setae begin in II, each bundle with 1-2 hairs and 1-2 needles. Hairs nearly straight, non-serrate, 108-210 μ long, about equal to body-diameter, in II nearly half, in III $\frac{3}{4}$ as long as, in following segments. Needles (Fig. 31 A) bifid, bayonet-shaped, nodulus distal (D : P : : 6 : 11), 53-65.5 μ long, teeth faintly diverging, unequal and blunt, proximal tooth twice as long and as thick as distal. Ventral setae (Fig. 31 B) all of one type, 4-5 per bundle, decreasing to 2-3 posteriorly, nodulus median (D : P : : 6 : 6.5 or 6 : 7) in anterior segments, and slightly distal (D : P : : 6 : 8) in rest ; shortest setae in II-III, 43.7-45.5 μ long, abruptly increasing to 52.5 μ in IV and decreasing in middle and hind segments ; with teeth about equally long, distal thinner than proximal.

Pharynx in II-IV, wide. Oesophagus in V-VI, thin and sinuous. Stomach in VII-$\frac{1}{2}$VIII, gradual and fusiform. Intestine thin in IX, wide from X on, opening by anus in a notch at hind end. Septa delicate and complete. Coelomocytes spherical, granular, largest 12 μ in diameter. Chloragogues cover gut from VI, brownish.

Blood yellowish red. Dorsal vessel attached laterally to left from hind end to VI, mid-dorsal in anterior 5 segments. Simple vascular vessels 6 pairs in II-VII, latter 4 pairs contractile.

First nephridium in IX with its nephrostome in VIII, post-septal coiled duct opens by nephridiopore ventro-laterally.

Budding occurs as seen in a single worm. As the worm was in early stage of budding, the number of segments budded off to posterior zooid cannot be stated. The presence of first nephridium in IX as in other

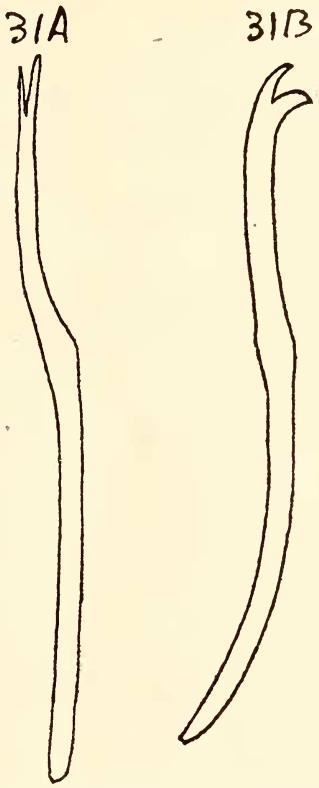

Fig. 31. *Pristina jenkinae* (Stephenson) : A. Needle seta × 1600 ; B. Ventral seta × 2000.

species of the genus, indicates that 7 anterior segments are budded off here also.

Sexual worm not encountered.

l (living) = 25 mm. ; d (living) = 0.17 mm. ; s = 22 + undifferentiated region ; n = 16 (in one).

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

	II	III	IV	V	VI	VII	VIII	IX	X
Hair	108.5	150.5	178.5	210	175	175	175	168	157.5
Needle	38.5	52.5	64.7	66.5	59.5	59.5	59.5	59.5	59.5
	4:7	6:9	6.5:12	7:12	6:11	6:11	6:11	6:11	6:11
V. seta	43.7	45.5	52.5	52.5	52.5	52.5	52.5	49	49
	6.5:6	6:7	7:8	7:8	7:8	7:8	7:8	6:8	6:8

Distribution in Indian sub-continent : Now recorded from Bellary (S. India); first record for the Indian sub-continent.

Habits : Swimming absent.

Remarks : The description given here is from a single non-sexual worm. The lengths of setae of the present worm agree very closely with those of Stephenson (1931a).

Sperber (1948) is undoubtedly right in pointing out that *Naidium roseum* Piguet of Marcus (1943) is identical with *Pristina jenkinae* (Stephenson). It agrees very closely with the present species in all respects.

Pristina rosea (Piguet) of Kondô (1936) certainly belongs here, as pointed out by Sperber, as its needles (Pl. 24, fig. 16a) are stated to resemble those of *Pr. jenkinae*, and its chalk-white colour agrees with that of latter, not with rose-coloured *Pr. rosea*. *Pr. rosea* (Piguet) of Michaelsen & Boldt (1932) may also belong here.

32. **Pristina aequiseta** Bourne, 1891

Fig. 32 A-D

Pristina aequiseta Bourne. Lastočkin, 1927. p. 67 ; Černosvitov, 1938, pp. 536, 538 ; Berg, 1948, p. 50 ; Sperber, 1948, pp. 230-232, fig. 24, pl. XXI fig. 5 ; 1950, p. 77, fig. 28b, pl. III fig. 8 ; Causey, 1953a, p. 55 ; 1953b, pp. 422-423; Yamaguchi, 1953, pp. 284-285, fig. 4.

Material examined : Numerous worms collected from the Bugga stream, Cuddapah, in February 1954; from the Balaji tank, Kakinada, in November 1956 ; from the Kandakam tank, Bellary, in April 1954.

Worms small and whitish. Prostomium with fairly long, mobile proboscis with sensory hairs. Anus in a notch bounded by rounded lobes on either side.

Dorsal bundles start in II, each bundle with 1-2 hairs and 1-2 needles. Hairs finely serrated, straight, 100-240 μ long, not specially elongated in III, increase in length from II-IV. Needles (Fig. 32 A) bifid, bayonet-shaped, 31-45 μ long, without nodulus and with fine teeth. Ventral setae (Fig. 32 B, C) 5-6 per bundle, in II, 52-56 μ long, thicker and longer than the rest, with nodulus slightly proximal (D : P : : 9 : 7), distal prong 1.5 times as long as proximal ; in III 43-45.5 μ long with slightly distal nodulus (D : P : : 6 : 7), distal prong slightly longer than proximal ; in IV giant setae 1-2 per bundle (Fig. 32 D), longest of all 66.5-70 μ long and peculiarly shaped, with distal prong strongly hooked and thicker than the rudimentary proximal prong and distal nodulus (D : P : : 8 : 11) ; in the rest 45-51 μ long, prongs of about equal length and thickness ; with slightly distal nodulus (D : P : : 6 : 7).

Pharynx in II-IV, wide with inner wall ciliated and roof eversible. Oesophagus in V-VII, thin and sinuous. Stomach in VIII, abrupt and pear-shaped with intracellular canals. Intestine thin and wavy in IX

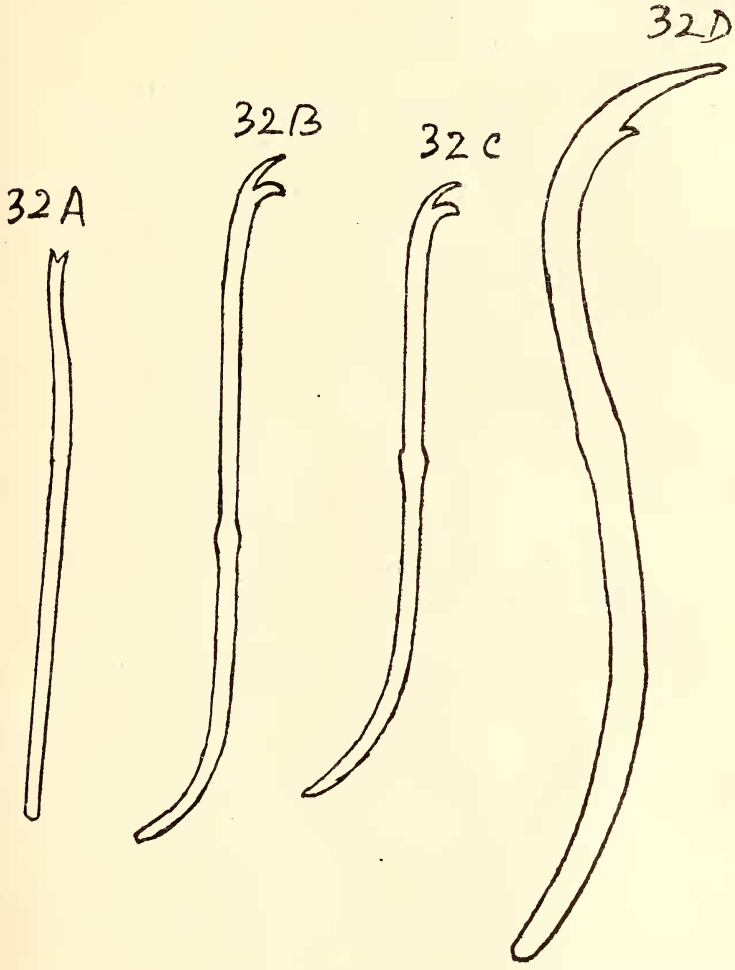

Fig. 32. *Pristina aequiseta* Bourne : A. Needle seta × 2000 ; B. Ventral seta of II × 2000 ; C. Ventral seta of IX × 2000 ; D. Giant ventral seta of V × 2000.

and wide from X. Chloragogues start in VI and greenish brown. Septal glands in III-V. Coelomocytes spherical, morula-like with grey granules, largest of 14 μ diameter.

Brain incised anteriorly and posteriorly.

Blood tinged with yellow. Dorsal vessel contractile and mid-dorsal. Contractile vascular vessels 6 pairs in II-VII connecting dorsal and ventral vessels.

First pair of nephridia in IX with pre-septal nephrostome in VIII.

Single budding zone common, two zones rare, second zone always developing in anterior zooid a segment in front of the first zone.

l (p.) = 1-1.5 mm. (single), 1.5-2 mm. (chain) ; d (p.) = 0.2 mm.; s = 17-20 ; n = 12-18.

Lengths of longest setae in μ and position of nodulus in the ratio D : P ::

	II	III	IV	V	VI	VII	VIII	IX	X
Hair	105	140	161	189	192.5	192.5	210	210	210
Needle	31.5	35	42	42	42	43.7	43.7	43.7	43.7
V. seta	56	45.5	66.5	49	49	49	45.5	45.5	45.5
	9:7	6:7	8:11	6:8	6:8	6:8	6:7	6:7	6:7

Distribution in Indian sub-continent : Calcutta, Allahabad (N. India). Now recorded from Cuddapah and Bellary (S. India).

Remarks : Setae of the present specimens agree in form with those in literature, and are slightly longer than those recorded by Piguet (1906) and Marcus (1943), and agree with those tabulated for a single Swedish specimen (Sperber, 1948, p. 231).

Pristina aequiseta var. ? from S. America (Michaelsen, 1913) and *Pr. aequiseta* Bourne from Germany (Hempelmann, 1923) and from south India (Aiyer, 1930) with giant ventral setae having a single hooked prong in V have been included in this species by Sperber (1948). These forms are actually *Pristina evelinae* Marcus, 1943.

33. **Pristina evelinae** Marcus, 1943

Fig. 33 A-D

Pristina aequiseta Bourne var.? Michaelsen, 1913, pp. 209-211.

Pristina aequiseta Bourne. Hempelmann, 1923, pp. 380-444 ; Aiyer, 1930, pp. 25-26, fig. 5.

Pristina evelinae Marcus. Sperber, 1948, p. 232, fig. 25.

Material examined : Several worms collected from the Bugga stream, Cuddapah, in January 1956 ; from the Langford Town tank, Bangalore, in May 1958.

Worms minute, brownish, capable of high contractility, hence very short in preserved condition. Proboscis longer than prostomium with sensory hairs. Anterior 7 segments shorter than following segments. Anus posterior in a notch between 2 lobes with sensory hairs.

Dorsal setae from II on, 1 hair and 1 needle per bundle. Hairs nearly straight 91-175 μ long, longer than diameter of body. Needles (Fig. 33 A) finely bifid, 28-42 μ long, slightly curved distally, nodulus distal (D : P : : 4 : 8), teeth fine, short, diverging. Ventral setae (Fig. 33 B, C) 4-7 per bundle, higher number in middle segments, 38.5-52.5 μ long ; in II, 49-52.5 μ long, longer than rest, in III, 38.5 μ long and

shortest. Nodulus proximal in II (D : P :: 8 : 7 or 8 : 6) and distal in others (D : P :: 5 : 7). Giant setae (Fig. 33 D) 1 per bundle in V, 70-77 μ long, single-pointed with double curve with shape resembling a pruning knife, nodulus strong and distal.

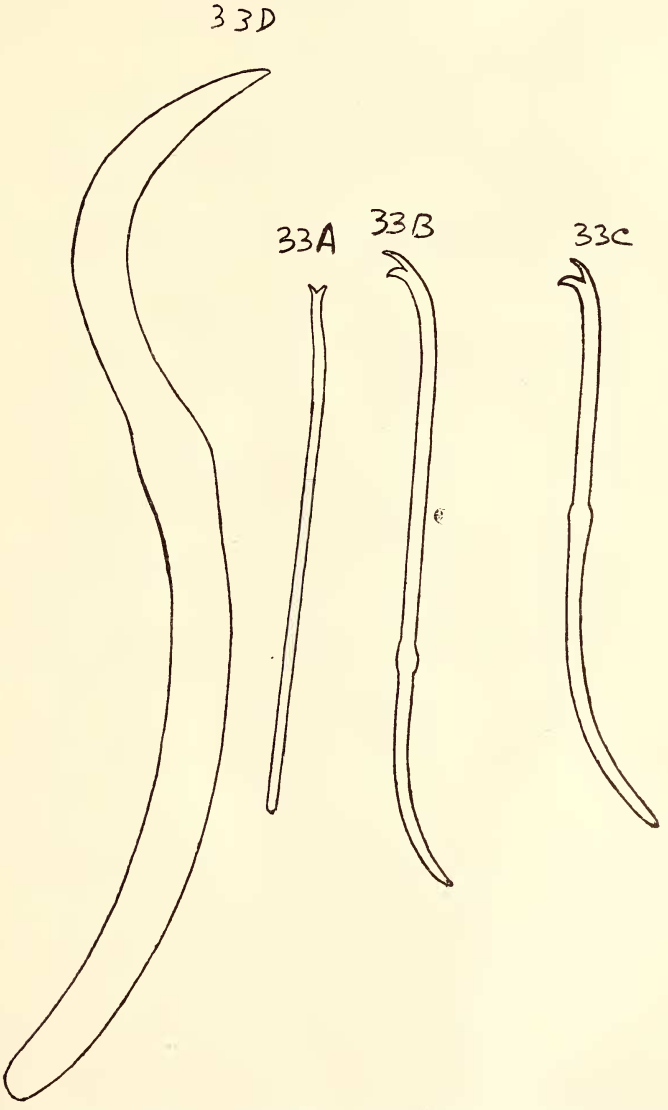

Fig. 33. *Pristina evelinae* Marcus : A. Needle seta × 2250 ; B. Ventral seta of II × 2250 ; C. Ventral seta of posterior segment × 2250 ; D. Giant Ventral seta of IV × 2250.

Pharynx in II-III, wide. Oesophagus in IV-VII, thin. Stomach abrupt and narrowing posteriorly with intracellular canals in VIII. Intestine

from IX onwards. Coelomocytes granular, spherical, largest 12 μ in diameter. Septal glands in III-V, whitish.

Brain incised in front and behind.

Blood red. Dorsal vessel mid-dorsal all along. Transverse commissural vessels from II-VII, enlarged and contractile in VI and VII.

First nephridium in IX, placed to left, with its pre-septal nephrostome in VIII.

One budding zone develops at a time.

Sexual worms not encountered.

l (p.) = 1.1-1.4 mm.; d (p.) = 0.14 mm.; s = 22 + undifferentiated zone ; n = 13-14.

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

	II	III	IV	V	VI	VII	VIII	IX	X
Hair	91	101.5	108.5	112	129.5	129.5	140	175	140
Needle	28	29.7	35	35	36.7	35	38.5	42	38.5
	3:5	3.5:5	4:6	4:6	4:6.5	4:6	4:7	4:8	4:7
V. seta	52.5	38.5	42	70	45.5	42	42	42	42
	8:7	5:6	5:7	8:12	5:8	5:7	5:7	5:7	5:7

Distribution in Indian sub-continent : Travancore (S. India). Now recorded from Cuddapah and Bangalore (S. India).

Remarks : Lengths of setae of the present worms agree with those of Aiyer (1930) and Marcus (1943).

Habits : Swimming absent. Live in aquatic plants and algae.

34. **Pristina longiseta longiseta** Ehrenberg, 1828

Fig. 34 A-K

Pristina longiseta Ehrenberg. Pointner, 1911, p. 634 ; Stephenson, 1916, p. 304 ; 1922, p. 282 ; 1931a, pp. 41-42, fig. 2 ; Lastočkin, 1924, p. 5 ; 1927, p. 66; Sperber, 1950, p. 77, pl. III, fig. 9 ; 1958, p. 52, figs. 18-19.

Pristina longiseta Ehrenberg f. *typica* Michaelsen ; Lastočkin, 1918, p. 59 ; 1924, p. 5 ; 1927, p. 66.

Pristina longiseta longiseta Ehrenberg. Sperber, 1948, pp. 236-237, pl. XXI, figs. 2, 6.

Material examined : Numerous worms collected from the Bugga stream, Cuddapah, all round the year ; from the Ulsoor tank, Bangalore, in May 1958.

Worms small, slender and light yellow. Prostomium (Fig. 34 A, B) with a mobile proboscis, latter longer than former, both with sensory hairs. Anus posterior in a notch between 2 lobes with sensory hairs (Fig. 34 C).

Dorsal bundles from II onwards, each bundle with 1-3 hairs and 1-3 needles. Hairs of III specially elongated, straight non-serrate, highly

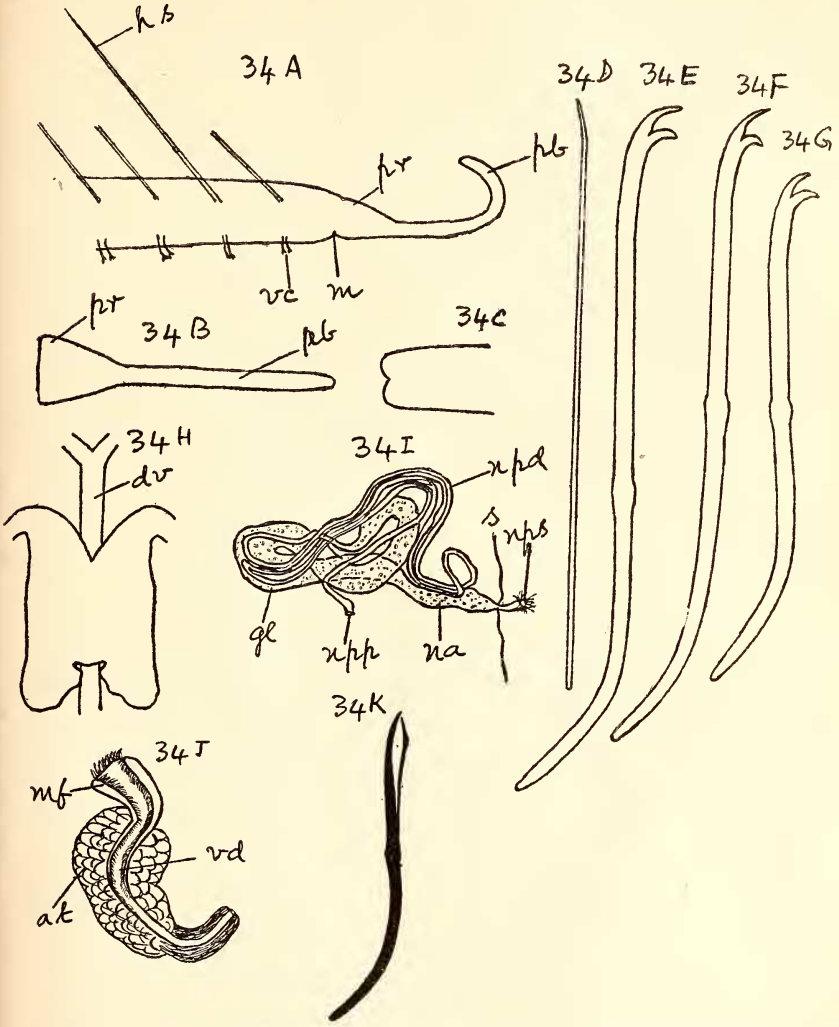

Fig. 34. *Pristina longiseta longiseta* Ehrenberg : A. Anterior part of the worm (lateral view) ; B. Prostomium (dorsal view) ; C. Posterior part of the worm (dorsal view) ; D. Needle seta × 1700 ; E. Ventral seta of II × 1700 ; F. Ventral seta of III × 1700 ; G. Ventral seta of posterior segment × 1700 ; H. Brain ; I. Nephridium ; J. Seminal funnel and atrium ; K. Genital seta × 650.

at : atrium ; *dv* : dorsal vessel ; *gl* : gland ; *m* : mouth ; *mf* : male funnel ; *na* : nephridial ampulla ; *npd* : nephridial duct ; *npp* : nephridiopore ; *nps* : nephrostome ; *pb* : proboscis ; *pr* : prostomium ; *s* : septum ; *vc* : ventral seta ; *vd* : vas deferens.

mobile, 658-714 μ long, reaching beyond tip of proboscis when turned forwards; in others nearly straight with close serrations on convex border, up to 315 μ long. Needles (Fig. 34 D) fine, straight with distal end simple pointed and curved, without nodulus, 35-49 μ long. Ventral

setae (Fig. 34 E, F, G) 4-5 per bundle in anterior segments and 5-6 in later segments ; in II longest, 63-66.5 μ long ; in others 49-56 μ long. In II and III nodulus proximal (D : P : : 11 : 7) and prongs equally thick, distal prong 1½ times longer than proximal, in others nodulus median to distal (D : P : : 7 : 7 and 6 : 7), prongs of equal length, distal thinner than proximal.

Pharynx in II-III, ovoid and ciliated with a dorsal diverticulum communicated by a longitudinal slit in roof. Oesophagus in IV-VII, thin and wavy. Stomach in anterior half of VIII, abrupt pear-shaped, thick-walled with intracellular canals. Intestine narrow in IX, wide from X on. Chloragogues start in VI, greenish grey. Septal glands on septa 4/5, 5/6 and 6/7. Coelomocytes colourless, spherical of 10 μ diameter with greyish granules.

Brain (Fig. 34 H) incised deeply in front and less deeply behind.

Blood light yellow. Dorsal vessel contractile and mid-dorsal ; ventral vessel non-contractile and mid-ventral. Simple contractile lateral vessels in II-VII, later pairs larger and more contractile.

First pair of nephridia (Fig. 34 I) in IX with pre-septal funnels in VIII, each funnel connected by a neck to post-septal, consisting of fusiform ampulla followed by a coiled, ciliated duct, partly free and partly enclosed in gland tissue, and opening by nephridiopore.

One budding zone common, two rare, second budding zone always develops in anterior zooid 3-4 segments in front of first zone.

Clitellum from ½VII—½IX (2 segments). Testes ovoid and white, attached to posterior face of septum 6/7. Sperm-sac, back-pouching of septum 7/8 extends to XI when full. Ovaries not clearly seen. Ovi-sac, back-pouching of septum 8/9, extend to XII when full. Sperm-funnels (Fig. 34 J) with wide ciliated openings, vasa deferentia short and wide, slightly bent on themselves and opening into atria. Atrium ovoid and glandular with short, thick ectal duct opening ventro-laterally in VIII. Spermathecal ampulla long and cylindrical with short ducts opening ventro-laterally in VII. Ventral setae of VI replaced by a pair of genital setae (Fig. 34 K) of 80 μ long, each with 2 long prongs converging distally.

As in *Stylaria fossularis* worms developing sex organs go through asexual reproduction repeatedly producing fission zones.

l (living) = 2-3 mm. (simple), 4-5 mm. (chain) ; d (living) = 0.12 mm. ; s = 22-26 ; n = 14-17.

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Hair	161	714	178.5	196	217	70	63	241.5	245	245	255.5
Needle	35	42	42	45.5	45.5	45.5	49	49	49	49	49
V. seta	63	52.5	49	49	45.5	56	52.5	52.5	52.5	52.5	52.5
	11:7	8:7	7:7	7.5:6.5	7:6	8:8	7.5:7.5	7.5:7	8:7	8:7	8:7

Distribution in Indian sub-continent : Calcutta (N. India) ; Bheemanagar, Trivandrum (Travancore, S. India) ; Bombay (W. India) ; Gwalior (C. India) ; Lahore (Pakistan). Now recorded from Cuddapah and Bangalore (S. India).

Parasites : Sporocysts of the microsporid sporozoan, *Mrazekia caudata* Leger & Hesse (Naidu, 1959a), were found in the coelom of two worms and of the actinomyxid sporozoan, *Triactinomyxon* sp. (Naidu, 1959b) were found in the gut wall of one worm.

Habits : No swimming. Backward progression present. Live in algae.

Remarks : Lengths of setae of the present specimens agree with those of the Swedish worms. Genital setae agree with those of Aiyer (1930).

Pristina longiseta Ehrenberg from W. Australia (Jackson, 1931) and *Pr. longiseta* Ehrenberg f. *typica* Michaelsen from East Indies (Michaelsen & Boldt, 1932) are probably identical with the present species. To determine their identity a re-investigation of the forms is necessary.

35. **Pristina sperberae**[1] sp. nov.

Fig. 35 A-D

Material examined : A few worms collected from the Bugga stream, Cuddapah, in October 1953, January 1954 and 1956.

Worms minute, slender, and whitish. Prostomium with proboscis, latter slightly longer than prostomium and does not snap. Both prostomium and proboscis bear sensory hairs. Eyes absent.

Dorsal bundles start in II, each bundle composed of 1 hair and 1 needle. Hairs non-serrate, nearly straight, 100-190 μ long, in III not specially elongated but slightly longer than hairs of II and slightly shorter than those of IV. Needles (Fig. 35 A) bifid, 28-35 μ long, with weak distal nodulus (D: P : : 2 : 10), curved above nodulus, with fine unequal and diverging teeth. Ventral setae (Fig. 35 B, C) 7-8 per bundle in anterior 7 or 8 segments, gradually decreasing to 4 posteriorly ; in II, 43.8-45.5 μ long, longer than the rest, with proximal nodulus and distal prong longer than proximal ; in III shortest 35-36.7μ long, with median nodulus (D : P : : 5 : 5.5) ; in others 38.5-45.5 μ long, with distal nodulus (D : P : : 5:7). Prongs about equal in thickness, distal longer than the proximal in anterior 7 segments, and prongs equally long, distal thinner than proximal in rest.

Pharynx in II-III, wide and ciliated, with eversible roof. Oesophagus in IV-VII, thin and wavy. Stomach in VIII abrupt, pear-shaped with

[1] Named after Dr. Christina Sperber of Uppsala, Sweden, for her valuable contribution on the taxonomy of the Naididae.

intracellular canals. Intestine thin and sinuous up to X, wide and sacculated from XI. Chloragogues start in VI, greenish grey. Coelomocytes morula-like, spherical with grey granules. Septa well developed, septal glands on septa 4/5, 5/6 and 6/7.

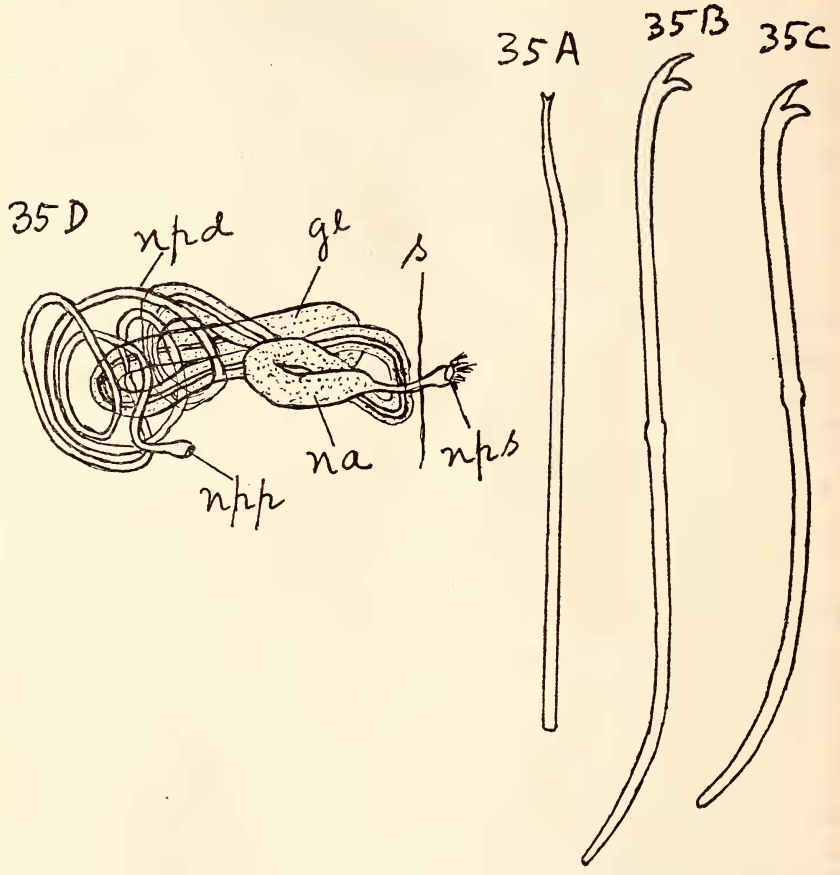

Fig. 35. *Pristina sperberae* sp. nov. : A. Needle seta × 3000 ; B. Ventral seta of II × 3000 ; C. Ventral seta of VIII × 3000 ; D. Nephridium.

gl : gland ; *na* : nephridial ampulla ; *npd* : nephridial duct ; *npp* : nephridiopore ; *nps* : nephrostome ; *s* : septum.

Brain incised deeply behind and less deeply in front.

Blood tinged with yellow. Dorsal vessel median on gut, covered partially by chloragogues and contractile. Transverse commissural loops in II-VII. Ventral vessel mid-ventral and non-contractile.

First pair of nephridia in IX and 1 in each of the succeeding segments. Each nephridium (Fig. 35 D) has pre-septal with nephrostome and a post-septal with a fusiform ampulla followed by a long, coiled, ciliated duct, partly passing through gland tissue and partly free, ending in nephridiopore.

One budding zone develops at a time.

Sexual worms not encountered.

l (living) = 1.5-2 mm. ; d (living) = 0.12 mm. ; s = 20 ; n = 14-15.

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

	II	III	IV	V	VI	VII	VIII	IX	X
Hair	98	101.5	122.5	164.5	154	164.5	189	185.5	185.5
Needle	28	31.5	35	35	35	35	35	35	35
	1.5:6.5	2:7	2:8	2:8	2:8	2:8	2:8	2:8	2:8
V. seta	45.5	36.7	45.5	43.7	42	42	40.3	38.5	38.5
	8:5	5:5.5	6:7	6:6.5	5:7	5:7	5:6.5	4.5:6.5	5:6

Type : The type specimen is being deposited with the Zoological Survey of India, Calcutta.

Habits : Lives among water plants and filamentous algae. No swimming.

Commensals : Sessile vorticillids are found attached to ventral setae.

Taxonomic remarks: The present species closely resembles *Pr. foreli* out of the 21 species recognized for the genus (Sperber, 1948). It differs from the latter in having lesser number of hairs and needles per bundle, (1 hair and 1 needle as against 1-4 hairs and 1-4 needles), smaller size of body (2 mm. as against 3-6.5 mm.), simple hairs (non-serrate as against serrate hairs), with shortest ventral setae in III (as against setae of normal length in *Pr. foreli*). Hence it is described here as a new species.

Diagnosis of Pristina sperberae *sp. nov.* : Prostomium with proboscis. Eyes absent. Dorsal setae from II on, 1 non-serrate hair and 1 bifid needle with fine teeth, weak distal nodulus and slight curve distally. Ventral setae 4-8 per bundle, of II longer and of III shortest with proximal nodulus ; in the rest nodulus distal ; in II-VII distal prong longer than proximal, from VIII prongs equally long. Stomach in VIII, pear-shaped with intracellular canals. Dorsal vessel mid-dorsal. Transverse commissural vessels in II-VII. n = 14-15 ; s = 20.

VI. Summary

Till 1958 the aeolosomatids and naidids known for the Southern region and Indian sub-continent were 27 and 36 species respectively. Recording of 18 species in this paper for the Southern region has established 45 species for the region and 54 species for the sub-continent [cf. pp. 643-644, *J. Bombay nat. Hist. Soc.* **58** (3)].

The thirty-five species treated here include 7 new species, and 11 new records for the Southern region, inclusive of 2 new records for the Indian sub-continent. They are *Nais menoni* sp. nov., *Dero indica* sp. nov., *D. plumosa* sp. nov., *Aulophorus hymanae* sp. nov., *A. indicus* sp.

nov., *Allonais rayalaseemensis* sp. nov., and *Pristina sperberae* sp. nov. The new records for the Southern region are all 3 species of *Chaetogaster*, *Stylaria fossularis*, *Haemonais waldvogeli*, *Dero cooperi*, *D. sawayai*, *Allonais gwaliorensis*, *Pristina minuta*, *Pr. jenkinae*, and *Pr. aequiseta*. Of these *Dero sawayai* and *Pristina jenkinae* are new records for the Indian sub-continent.

All the 35 species treated here were collected by the author in the ten localities [see p. 640, *J. Bombay nat. Hist. Soc.* **58** (3)]. A record collection of 32 species belonging to the Aeolosomatidae and Naididae was made from the Bugga stream, Cuddapah. From the other localities 1-11 species of worms were collected. Geographical distribution of all the forms is tabulated [see pp. 643-645, *J. Bombay nat. Hist. Soc.* **58** (3)].

The section on systematics deals with the descriptions of new species and redescriptions of known species of worms. *Lastočkinia* gen. nov.[1] is created for an aberrant species, *Aeolosoma niesvestnovae* Lastočkin, with its diagnosis. Stephensonianinae nov. is created for the reception of a solitary genus *Stephensoniana* Černosvitov, with its diagnosis. Key to all the genera of the Aeolosomatidae, key to all the known and valid species of *Aeolosoma* are given. Also, the key to subfamilies of the Naididae, keys to all the genera of the subfamilies, and keys to all the known and valid species of *Chaetogaster*, *Nais*, *Stylaria*, *Branchiodrilus*, *Allonais*, *Pristina*, *Dero*, and *Aulophorus* are given. Diagnostic characters of twelve genera and subgenera treated here are given.

Description of each species includes external characters, details of setae, internal anatomy, budding zones, sex organs, habits of worms, etc. Prostomium is rudimentary in *Chaetogaster*, simple and triangular in others except in *Stylaria fossularis* and *Pristina* (except in *Pr. minuta* and *Pr. jenkinae*) which have antero-median proboscis. Eyes are present only in *Nais communis* and *Stylaria fossularis*.

Dorsal bundles of setae begin in II in *Pristina*, *Stephensoniana trivandrana* ; from IV in *Dero dorsalis* ; from V in *Aulophorus* (except in *A. tonkinensis*); from VI in *Dero*, *Stylaria fossularis*, all *Nais*, *Allonais*, and *Aulophorus tonkinensis* ; from V or VI in *Branchiodrilus semperi*. They are absent in *Chaetogaster*.

Hair setae plumose in *Dero plumosa* sp. nov., bayonet-shaped in 15 species, and straight or slightly curved in 16 others. Needle setae are simple-pointed in *Aeolosoma*, *Stylaria fossularis*, *Branchiodrilus*

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[1] Ruttner-Kolisko (1955) has created genus *Rheomorpha* to receive the aberrant species *Aeolosoma neisvestnovae* Lastočkin. Hence *Lastočkinia* gen. nov. [see pp. 645-646, *J. Bombay nat. Hist. Soc.* **58** (3)] created in the present paper to receive the above species is invalid and the name *Lastočkinia* is *nomen nudum*.

semperi, *Stephensoniana trivandrana*, and *Pristina longiseta longiseta*; in the first two they are bayonet-shaped, in the later two they are straight, in the last two they are straight but with distal part curved. Needle setae are pectinate in *Aulophorus indicus* and *Allonais inaequalis*, oar-shaped in *Aulophorus tonkinensis*, and bifid with sickle or bayonet-shape in others. Giant ventral setae are observed in IV of *Pristina aequiseta* and in V of *Pr. evelinae*. Penial setae are observed only in *Nais communis*, *Stylaria fossularis*, all species of *Allonais*; and genital setae in *Pristina longiseta longiseta* among those in which the sexual worms were examined.

Gilled forms are *Branchiodrilus semperi* with dorso-lateral gills in anterior and middle segments; all species of *Dero* and *Aulophorus* with gills situated posteriorily in branchial fossa.

Stomach is absent in *Haemonais waldvogeli*, *Branchiodrilus semperi*, *Dero dorsalis*, *Aulophorus furcatus*, *A. michaelseni*, *A. hymanae*, and *Stephensoniana trivandrana*. Intracellular canals observed in stomachal wall of *Pristina aequiseta*, *Pr. evelinae*, *Pr. longiseta longiseta*, and *Pr. sperberae* are absent in *Pr. synclites*, and are not known from *Pr. minuta* and *Pr. jenkinae*. Anti-peristalsis and ascending ciliary vibration of intestine occur in all the species treated here except in *Chaetogaster*.

Dorsal vessel is mid-dorsal in *Aeolosoma*, *Chaetogaster*, and *Pristina* (lateral in *Pr. synclites*), and ventro-lateral in all others. Blood is colourless in *Aeolosoma* and *Chaetogaster*, and coloured in others, the colour varying from pale yellow to bright orange-red. Statocyst in the brain, hitherto not reported, is reported for *Chaetogaster cristallinus*.

Nephridia commence in II or III in *Aeolosoma*, in VI or VII in *Chaetogaster*, in VI in *Stephensoniana trivandrana*, in VIII or IX in *Aulophorus tonkinensis*, in X in *Aulophorus indicus*, in XII in *Branchiodrilus semperi*, in IX in *Pristina*, and in VII or VIII in all others. They are exonephric in *Chaetogaster* and coelomonephric in others.

Asexual reproduction is by formation of budding zones in all species treated here except in *Allonais*, where fragmentation occurs. Prostomium and 4 anterior segments are produced in *Stephensoniana trivandrana*, 7 in *Pristina*, and 5 in all others. The anterior segments of the posterior zooid start budding only after complete formation of the hind part of the anterior zooid in *Pristina synclites*. Positions of testes and spermathecae, and ovaries and atria are in VII and VIII in *Pristina longiseta longiseta*, and in V and VI in others in which sexual worms were examined.

Among the Naididae the species of *Dero* and *Aulophorus* are known to construct tubes of mucus and foreign matter to live in. Of the 8 species of *Dero* and 5 species of *Aulophorus* treated here all were

observed to live in tubes except 3 species of *Dero* and 2 of *Aulophorus*. *Stephensoniana trivandrana* lives in soft mud and has a part of its body covered by thin mucus film studded with mud particles. Among the species of *Aeolosoma*, *Ae. travancorense* live in tubes much larger than their body, evidently tubes vacated by larger species of worms.

Swimming was observed in *Nais menoni* sp. nov., *Stylaria fossularis*, all species of *Dero*, *Aulophorus*, *Allonais* (except in *Dero dorsalis* and *Aulophorus indicus*) and in *Stephensoniana trivandrana*. Species of *Aeolosoma* glide on substratum like turbellarians. *Chaetogaster cristallinus*, *Ch. diastrophus*, all species of *Nais*, *Allonais*, *Pristina* (except *Pr. synclites*), and *Stylaria fossularis* live in filamentous algae and water plants ; others live in soft mud. *Chaetogaster langi* lives in encrustations of plant and animal matter.

Vorticellids were observed as commensals attached to the setae of *Chaetogaster cristallinus*, *Nais communis*, *Dero digitata*, *Aulophorus hymanae*, *Allonais gwaliorensis*, and *Pristina sperberae*. Some holotrichous astom tous ciliate parasites were found in the gut of *Aeolosoma travancorense*, *Chaetogaster cristallinus*, *Allonais gwaliorensis*, and *Stephensoniana trivandrana*; sporocysts of actinomyxid sporozoan parasites were found in the gut wall of *Nais communis* and *Pristina longiseta longiseta* ; and sporocysts of microsporid sporozoan parasites were found in the coelom of *Nais communis*, *Dero sawayai*, and *Pristina longiseta longiseta*.

References

Aiyer, K. S. P. (1925) : Notes on the Oligochaeta of Travancore I. *Ann. Mag. nat. Hist.* (9) **16** : 31-40.

— — — (1926) : Notes on the Oligochaeta of Travancore II. *Ann. Mag. nat. Hist.* (9) **18** : 131-142, pl. 5 and 6.

— — — (1930) : An account of the Oligochaeta of Travancore. *Rec. Ind. Mus., Calcutta.* **31** : 13-76, pl. 1-5.

Annandale, N. (1906) : Notes on the freshwater fauna of India. V. Some animals found associated with *Spongilla carteri* in Calcutta. *J. Asiat. Soc. Beng.* **2** : 187-190.

Beddard, F. F. (1895) : A monograph of the order of Oligochaeta. Oxford. xii + 769, 5 pl.

Benham, W. B. (1893) : Note on a new species of the genus *Nais*. *Quart. J. Micr. Sci.* (N.S.) **34** : 383-386, pl. 33.

Berg, K. (1948) : Biological studies on River Suasa. *Folia Limnol. Scand. Kobenhava.* **4** : 1-318, pl. 1-7, tables 1-5.

Bousefield, E. G. (1886) : On the Annelids of genus *Dero*. *Rep. Brit. Assoc. Adv. Sci., London.* 1885: 1097.

— — — (1887) : The natural history of the genus *Dero*. *J. Linn. Soc., London* **20** : 91-107, pl. 3-5.

Bretscher, K. (1896): Die Oligochaeta von Zurich. *Rev. Suisse Zool.* **3** : 499-532, 4 fig.

Brode, H. S. (1898) : Contribution to the morphology of *Dero vaga*. *J. Morph.* **14** : 141-180, pl. 13-15.

Causey, D. (1953a) : On Arkansas Microdrili. *Proc. Ark. Acad. Sci.* **6** : 53-60.

— — — (1953b) : Microdrili in Artificial Lakes in North-West Arkansas. *Amer. Midland Nat.* **50** : (2) : 420-425.

Černosvitov, L. (1930) : Oligochaeten aus Turkestan. *Zool. Anz.* **91** : 7-15.

— — — (1937) : Notas sur les Oligochaeta (Naididées et Enchytraedées) de l' Argentine. *An. Mus. Argent. Sci. Nat. B. Aires* **39** : 135-157.

— — — (1938) : Oligochaeta. Washbourn and Jones : Report of the Percy Sladen Expedition to Lake Huleh. *Ann. Mag. nat. Hist.* (11) **2** : 535-550.

— — — (1942) : Oligochaeta from various parts of the world. *Proc. Zool. Soc., London* (B) **111** : 197-236, 73 figs.

Chen, Y. (1940) : Taxonomy and faunal relations of the limnitic Oligochaeta of China. *Contr. biol. Lab. Sci. Soc. China, Nanking.* **14** : 1-132.

CHEN, Y. (1944) : Notes on Naidimorph Oligochaeta of Philadelphia and vicinity. *Notulae Naturae Acad. Nat. Sci. Philadelphia* **136** : 1-8, 3 figs.

CHU, J. (1945) : A genealogical analysis of fission in *Stylaria fossularis*. *Proc. Zool. Soc., London* **115** (1/2) : 194-206, 8 figs.

— — — (1946) : Further experiments on the relation between natural fission and regeneration in *Stylaria fossularis*. ibid. **116** (2) : 229-239, 7 figs.

CORDERO, E. H. (1931a) : Notas sobre los Oligochetos del Uruguay (primera serie). *An. Mus. Nac. Hist. Nat. B. Aires* **36** : 342-357.

— — — (1931b) : Die Oligochaeta der Republic Uruguay I. *Zool. Anz.* 92 : 333-336.

*CRAGIN, F. W. (1887) : First contribution to knowledge of lower Invertebrata of Kansas. *Bull. Washburn coll. Topeka* **2** (8) : 27-32.

DAHL, I. O. (1957) : Results from the Danish Expedition to the French Cameroons, 1944-50. XII Oligochaeta. *Bull. de l'I. F. A. N.* **19**, ser. A, No. 4 : 1154-1172, 7 figs.

*EHRENBERG, C. G. (1828) : Symbolae physicae—. Animalia evertebrata. Phytozoa. Berlin.

GALLOWAY, T. W. (1911) : The common freshwater Oligochaeta of United States. *Trans. Amer. Micro. Soc.* **30** : 285-317.

*GERVAIS, P. (1838) : Note sur la disposition systematique des Annelides chaetopodes de la famille des *Nais*. *Bull. Acad. Bruxelles* **6** : 13.

HAYDEN, H. E. (1922) : Studies on American Naid Oligochaetes. *Trans. Amer. Micr. Soc.* **41** : 167-171.

HEMPELMANN, F. (1923) : Kausalanalytische Unterschungen über das Auftreten vergrosserter Borsten und die Lage der Teilungszone bei *Pristina*. *Arch. mikr. Anat. Entwick.* **98** : 379-445.

HRABE, S. (1937) : Contribution A l'etude du genre *Trichodrilus* (Oligoch., Lumbriculidae) et description de deux éspèces nouvelles. *Bull. Mus. Hist. nat. Belge* **13** (32) 1-23.

— — — (1939) : Oligochetes aquatiques des Hantes Tatras. *Vest. Cs. Zool. Spol.* **6-7** : 209-236.

— — — (1941) : Zur Kenntnis der Oligochaeten aus der Donau. *Acta Soc. Sci. nat. Moraviae* **13** (12) : 1-36. (Czech with German summary).

— — — (1952) : The Zoology of Iceland. pp. 1-10.

JACKSON, A. (1931) : The Oligochaeta of South-western Australia. *J. Roy. Soc. W. Aust.* **17** : 71-136, pls. 14-16.

KENK, R. (1941) : Notes on three species of *Aeolosoma* (Oligochaeta) from Michigan. *Occas. Pap. Mus. Zool. Mich.* No. 436 : 1-8, pl. 1.

KONDÔ, M. (1936) : A list of Naidiform Oligochaeta from the waterworks plant of the city of Osaka. *Annot. Zool. Jap.* **15** : 382-393, pls. 23-24.

LASTOČKIN, D. A. (1918) : Materially do faune vodnych Oligochaeta. *Trav. Soc. Nat. Petrograd* **44** : 57-64. (Russian with German summary).

— — — (1924) : 'Oligochaeta' Valdaiskogo ozera. *Tr. Ivan.-Vozn. Gub. Nauchin* **2** : 1-8. (Russian with German summary).

— — — (1927) : Beiträge zur Oligochaetenfauna Russlands III. Fauna-von *Oligochaeta limicola* in Gouvernements Iwauowa-Waznesensk und Wladimir. *Izv. Ivanovo-Vozn. Polyt. Ist.* 10 : 65-76. (Russian with German summary).

— — — (1935a) : Two new River Aeolosomatidae (Oligochaeta limicola). *Ann. Mag. nat. Hist.* (10) **15** : 636-645.

— — —(1935b) : New name for the genus *Stephensoniella* Lastočkin. (Oligochaeta). ibid. (10) **16** : 488.

LEIDY, J. (1850) : Descriptions of some American Annelida abranchia. *J. Acad. nat. Sci. Philad.* (2) **2** : 43-50.

MALEVICH, I. I. (1929) : Die Oligochaeten der Gewasser der Meschtschera —Niederung. *Arb. biol. Sta. Kossino* **9** : 41. (Russian with German summary).

MARCUS, E. (1943) : Sobre Naididae do Brasil. *Bol. Fac. Filos. cien. Let. Univ. S. Paulo* 32, Zool., 7 : 3-247, 33 pls. (Portuguese with English summary).

— — — (1944) : Sobre oligochaeta limnicos do Brasil. ibid. 43, Zool., **8** : 5-135, 17 pls. (Portuguese with English summary).

MARCUS, E. DU-BOIS R. (1944) : Notes on freshwater Oligochaeta from Brazil. *Commun. Zool. Mus. Hist. nat. Montevideo* 1.20 : 1-8, 2 pls.

— — — — — (1947) : Naidids and Tubificids from Brazil. ibid. 2. 44 : 1-18, pls. 1-3.

— — — (1949) : Further notes on Naidids and Tubificids from Brazil. ibid. 3. 51 : 1-11, pls. 1-2.

MAYHEW, R. L. (1922) : The anatomy of some sexually mature specimens of *Dero limosa* Leidy. *Trans. Amer. Micr. Soc.* **41** : 159.

MEHRA, H. R. (1920) : On the sexual phase in certain Naididae (Oligochaeta). *Proc. Zool. Soc. London* 1-4 : 457-465.

MICHAELSEN, W. (1900) : Oligochaeta. Das Tierreich. 10. Berlin. xxix + 575 pp.

— — — (1903) : Die geographische Verbreitung der Oligochaeten. Berlin. vi + 186 pp. 9 maps.

— — — (1905) : Die Oligochaeten Deutsch-Ostafrica. *Z. Wiss. Zool.* **82** : 288-367, pls. 19-20.

MICHAELSEN, W. (1913) : Die Oligochaeten Columbias. Fuhrmann and Mayr : Voyage d'exploration scientifique en Colombie. *Mem. Soc. Neuchatel Sci. nat.* **5** : 202-252, pl. 8.

— — — (1914) : Oligochaeta. Beiträge zur Kenntnis der Land- und Susswasserfauna Deutsch-Sudwestafrica **1** : 137-182, 4 pls.

— — — (1933): Suss- und Brackwasser-Oligochaeten von Bonaire, Curaçao und Aruba. *Zool. Jahrb. Syst.* **64** : 327-350, pl. 1.

— — —, & BOLDT, W. (1932) : Oligochaeta der deutschen limnologischen Sunda-Expedition. A. Theinemann : Tropische Binnengewasser II. Arch. Hydrobiol. Stuttgart. Suppl., **9** : 587-622, pls. 12-13.

NAIDU, K. V. (1956) : A new species of Actinomyxid Sporozoan parasite in a freshwater oligochaeta. *J. Protozool.* **3** : 209-210, fig. 1.

— — — (1959a) : Occurrence of a microsporidian (Protozoa) parasite in freshwater oligochaetes. *Curr. Sci.* **28** (5) : 212.

— — — (1959 b) : *Triactinomyxon* sp. (Actinomyxid sporozoan : Protozoa) parasitic in a freshwater oligochaete. *J. Zool. Soc. India* **11** (1) : 39-42.

NICHOLLS, G. E. (1921) : On a new species of naidiform worm, *Dero roseola*. *J. Roy. Soc. W. Aust.* 7 : 90-94, pl. 14.

OYE, P. VAN. (1927) : Courte note au suj et du genre *Aeolosoma* au Congo Belge. *Rev. Zool. Afric.* **15** (3): 359-360.

PASQUALI, A. (1938a) : Note sistamatiche sugli Oligocheti aquicoli di Padova. *Zoologia* **9** : 19-24.

— — — (1938b) : Note biologiche sugli Oligocheti aquicoli di Padova. ibid. **9** : 25-35.

PIGUET, E. (1906) : Observations sur les Naididées et revision systematique de quelques èspèces de cette famillé. *Rev. Suisse Zool.* **14** : 185-315, pls. 9-12.

— — — (1913) : Notes sur les Oligochetes. ibid. **21** : 111-146, 12 figs.

— — — (1928) : Sur quelques Oligochaetes de l'Amerique du Sud et de l' Europe. *Bull. Soc. Neuchatel. Sci. nat.* (N. S.) **52** : 78-101.

POINTNER, H.(1911): Beiträge zur Kenntnis der Oligochaetenfauna der Gewasser von Graz. *Z. Wiss. Zool.* **98** : 626-676, pls. 28-29.

RUTTNER-KOLISKO, A. (1914) : Über Oligochaetenb efunde der Lunzar-Seen. *Arch. Hydrobiol.* **10** : 91.

— — — (1955) : *Rheomorpha neisvestnovae* und *Marinellina flagellata*—zwei phylogenetisch interessante wurmtypen aus dem Suswasserpsammon. *Osterr. zool. Zeitscher.*, Bd. VI, H. 1/2 : 56-69.

SCHMARDA, L. (1861) : Neue wirbellose Thiere 1, II. Leipzig. pp. 7-14, pls. 17-18.

SCHUSTER, R. W. (1915) : Morphologische und bilogische Studien an Naiden in Sachsen und Bohmen. *Int. Rev. Hydrobiol.* 7, Biol. Suppl. 2, p. 1.

SEMPER, C. (1877): Beiträge zur Bilogie der Oligochaeten. *Arb. Inst. Wurzburg* **4**: 65-108, pl. 4.

SMITH, F. (1900): Notes on species of North American Oligochaeta III. *Bull. Ill. Lab. nat. Hist. Urbana.* **5**: 441-452, pls. 34-39.

— — — (1918) (1945): Aquatic earthworms and other bristle-bearing worms. Ward and Whipple : Freshwater Biology, New York.

SPERBER, C. (1948) : A taxonomical study of the Naididae. *Zool. Bidr. Uppsala* **28**: 296, 29 figs., 21 pls.

— — — (1950): A guide for the determination of European Naididae. ibid. **29**: 45-78, 28 figs., 3 pls.

— — — (1958): Über einige Naididae aus Europa, Asien und Madagaskar. *Ark. Zool. Stockholm* **12** (2): 45-53, 19 figs.

STEPHENSON, J. (1909): Report on a collection of smaller Oligochaeta made by Capt. F. H. Stewart, I. M. S., in Tibet. *Rec. Ind. Mus.* **3**: 105-144, pl. 8.

— — — (1909a) : The anatomy of some aquatic Oligochaeta of the Punjab. *Mem. Ind. Mus.* **1** (3): 255-281, pls. 15-20.

— — — (1911) : On some aquatic Oligochaeta in the collection of the Indian Museum. ibid. **6**: 203-214.

— — — (1913a) : On a collection of Oligochaeta, mainly from Ceylon. *Spolia Zeylan.* **8**: 251-276, pls. 1-2.

— — — (1913b): On intestinal respiration in Annelids ; with considerations on the origin and evolution of the vascular system in the group. *Trans. Roy. Soc. Edinburgh* **49**: 735-829.

— — — (1914): On a collection of Oligochaeta, mainly from northern India. *Rec. Ind. Mus.* **10**: 321-365, 7 figs., pl. 36.

— — — (1915a): On a rule of proportion observed in the setae of certain Naididae. *Trans. Roy. Soc. Edinburgh* **50**: 783-788.

— — — (1915b) : On the sexual phase in certain Naididae. ibid. **50**: 789-795, pls. 1.

— — — (1916) : On a collection of Oligochaeta belonging to the Indian Museum. *Rec. Ind. Mus.* **12**: 299-354, pls. 30-32.

— — — (1920): On a collection of Oligochaeta from the lesser known parts of India and from Eastern Persia. *Mem. Ind. Mus.* **7**: 191-261, pls. 9-10.

STEPHENSON, J. (1922) : On some Scottish Oligochaeta, with a note on encystment in a common freshwater Oligochaete *Lumbriculus variegatus* (Müll.). *Trans. Roy. Soc. Edinburgh* **53**: 277-295.

— — — (1923) : Oligochaeta. The Fauna of British India : London. xxiv+ 518 pp., 262 figs.

— — — (1925a): Oligochaeta from various regions. *Proc. Zool. Soc. London* **3-4**: 879-907, 3 pls.

— — — (1925b) : On some Oligochaeta mainly from Assam, South India and the Andaman Islands. *Rec. Ind. Mus.* **27**: 43-74, pls. 3-4.

— — — (1930): Oligochaeta. Oxford. xvi+978 pp.

— — — (1931a): Oligochaeta from Burma, Kenya, and other parts of the world. *Proc. Zool. Soc. London* **1-2** : 33-92.

— — — (1931b) : Oligochaeta from Brasil and Paraguay. *J. Linn. Soc. London* **37** : 291-326, pls. 17-18.

— — — (1932) : Report on the oligochaeta : Mr. Omer-cooper's investigation of the Abyssinian freshwaters. *Proc. Zool. Soc. London* **1-2** : 227-256.

STIEREN, A. (1892) : Über einige *Dero* aus Trinidad. *Sitz. Ber. Naturf. Ges. Dorpat.* **10** : 103-123, pl. 1.

SVETLOV, P. (1924) : Beobachtungen über Oligochaeta des Gouvernements Perm II. *Bull. Inst. Rech. biol. Perm.* **3** : 187-198, pl. 1, 8 figs. (Russian with German summary).

— — — (1925) : Einige Angaben über die Oligochaetenfauna des Tscherdynbezirkes (Uralgebeit). ibid. **3** : 471-475, pl. 1, fig. 2. (Russian with German summary).

SVETLOV, P. (1926) : Zur Kenntnis der Oligochaetenfauna des Gouv. Samara. ibid. **4** : 249-256. (Russian with German summary).

— — — (1946) : To the fauna of Oligochaeta of Tomsk Region. *Tp. Tomsk. roc. yh.-Ta. T.* **97** : 103-106. (Russian with English summary).

UDE, H. (1929) : Oligochaeta. F. Dahl : Tierwelt Deutschlands **15** : 132, 165 figs.

VAILLANT, L. (1890) : Histoire naturelle des Anneles marins et d'eau douce. 3. Paris.

VEJDOVSKY, F. (1894) : Description du *Dero tonkinensis* n. sp. *Mem. Soc. Zool. Fr.* **7** : 244-245.

WALTON, L. D. (1906) : Naididae of Cedar Point, Ohio. *Amer. Nat.* **40** : 683-706.

WESENBERG-LUND, C. (1937) : Ordo Oligochaeta : Regnorme, Ferskvandsfauaen biologisk belyt. Invertebrata. 1 : 320-354, 10 pls. Kobenhavn.

YAMAGUCHI, H. (1953) : Studies on the aquatic Oligochaeta of Japan. VI. A systematic report, with some remarks on the classification and phylogeny of the Oligochaeta. *J. Fac. Sci. Hokkaido Univ.*, ser. 6, **11** (2) : 277-342, 25 figs., pl. 7.

— — — (1957) : On *Aeolosoma hemprichi* Ehrenberg, obtained from subterranean water in Japan. ibid. **13** : 1-4.

YOSHIZAWA, H. (1928) : On the aquatic oligochaete, *Stylaria lacustris* L. *Sci. Rep. Tohoku Univ.* (4) **3** : 587.

* Not seen in original.